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Review, 2 October 2017

Title: Snowfall in the Alps: Evaluation and projections based on the EURO-CORDEX regional climate models

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Recommendation: [Revision]

GENERAL COMMENTS:

To start with, the authors have adequately dealt with the 1st and 3rd major point I raised in my review of the first revised manuscript.

However, their response to the 2nd major point came as a big surprise to me, even more so because the editor had pointed out an elegant way to solve the issue of not presenting the results from the HadGEM2-ES forced RACMO simulation. Instead the authors have chosen to take out the ECEARTH-RACMO and the IPSL-WRF simulation based on a new line of argumentation.

The authors now state that snow depth issues themselves are not the real problem in their study but rather the adverse feedback from snow depth issues on future temperature trends, which cannot be adequately dealt with by their bias-adjustment method. That may be so, yet I really wonder why they haven't considered this aspect right from the beginning. I also want to remind them that in the first revised manuscript they only used the snow depth issue as an argument to exclude a model chain without mentioning the role of temperature: "The HADGEM2-KNMI experiments were excluded due to serious snow accumulation issues over the European Alps." (part of footnote in section 2.2). (Snow accumulation issues is unfortunate phrasing, snow depth issues is much more adequate in this respect.)

According to Fig R1 in the rebuttal the RACMO- and WRF-simulations in particular suffer from adverse temperature effects owing to problems in snow depth. I won't dispute that there is a problem, but as I argued in my previous review this is primarily apparent in summer. The authors agree on that, but because problems in the transition seasons cannot be ruled out they have decided to take out both model chains altogether.

However, what the authors forget to mention in their rebuttal –and that is really unfortunate - is that their Fig R1 shows the temperature change signal of four models for the *summer* season, which is precisely the season they had left out from their analysis. What they should have done instead is displaying the temperature change signal for the rest of the year (September-May).

To underline my point I have generated two figures showing the temperature change signal for all models involved (using the ordering in their original manuscript and 1st revision, supplied with HadGEM2-RACMO in the 15th panel) for the summer season (Figure A) and the rest of the year (Figure B). To facilitate the comparison, I have tried to match the spatial extract and color scheme used in the Fig. R1 as much as possible. I've added distinct colors for values outside their color bar below +1K and above +7K.

The JJA temperature change patterns in Figure A for the model-chains ECEARTH-RACMO, HADGEM2-RACMO, ECEARTH-HIRHAM, IPSL-WRF, are very similar to the patterns displayed in the author's figure Fig. R1, though there seems a discrepancy for ECEARTH-

HIRHAM, perhaps related to the fact that there are quite a few points for this model chain with temperature changes below +1K outside the range displayed in Fig R1. Nonetheless , the resemblance for the other three model chains is striking and this convincingly shows that Fig. R1 indeed corresponds to the summer season. Note also that the model chains including RCA4 have issues as well in JJA temperature change signal with mostly (very) high values over the Alps alternated with some very low values, probably for grid cells at the highest elevations.

Yet, the results in Fig. A or Fig. R1are simply not relevant for this manuscript, because the authors have, for good reasons, confined their analysis to the September-May period of the year. The temperature change signals of the 15 model chains, displayed in Figure B, show a mixture of very smooth patterns (in particular the chains involving CCLM) to somewhat more varying patterns for the other model chains, most of the variation clearly induced by variation in altitude. However, none of the patterns shows disturbingly large and/or spurious variations.

From Figure B, I conclude that the temperature change signals derived for the September-May period of the year offer no ground to exclude any of the model chains from the analysis. If, based on this figure you decide to take out ECEARTH-KNMI from the analysis, I would argue that you should remove for the very same reason the model chains involving RCA4, REMO2009, ALADIN, and probably HIRHAM5 as well.

I strongly urge the authors to stick to the original selection of model chains, including ECEARTH-RACMO and IPSL-WRF, and add HADGEM-KNMI to the selection, because there is no (scientific) reason to leave it out. I also checked that IPSL-WRF output has not been withdrawn from EGSF, so I don't see a good reason to take out that model chain after you had submitted the initial manuscript.
For future reference it would be very useful to add a paragraph to the manuscript pointing out that some individual model chains suffer from snow depth issues which have detrimental impacts on near-surface temperatures in the summer season, but that such behaviour is hardly apparent in the rest of the year, and hence does not adversely affect your analysis. As the editor already pointed out the previous time you can use the supplementary information to elaborate on that.

Finally, the role of the upcoming CH2018 Swiss scenarios is interesting but not really decisive for the choices made in the manuscript. First, CH2018 has a much broader context than the study this manuscript reports on. Also CH2018 serves another purpose and audience than the scientific journal in which this manuscript is meant to be published. Lastly, and relevant here, the original manuscript was submitted in the beginning of 2017, prior to publication of the SH2018 model set documentation. Moreover, in the original manuscript there was no mentioning whatsoever of CH2018. (Why not?) So, in my opinion the decisions made in preparation of CH2018 do not provide justifiable reasons to change the selection of model chains during an ongoing review and revision procedure.

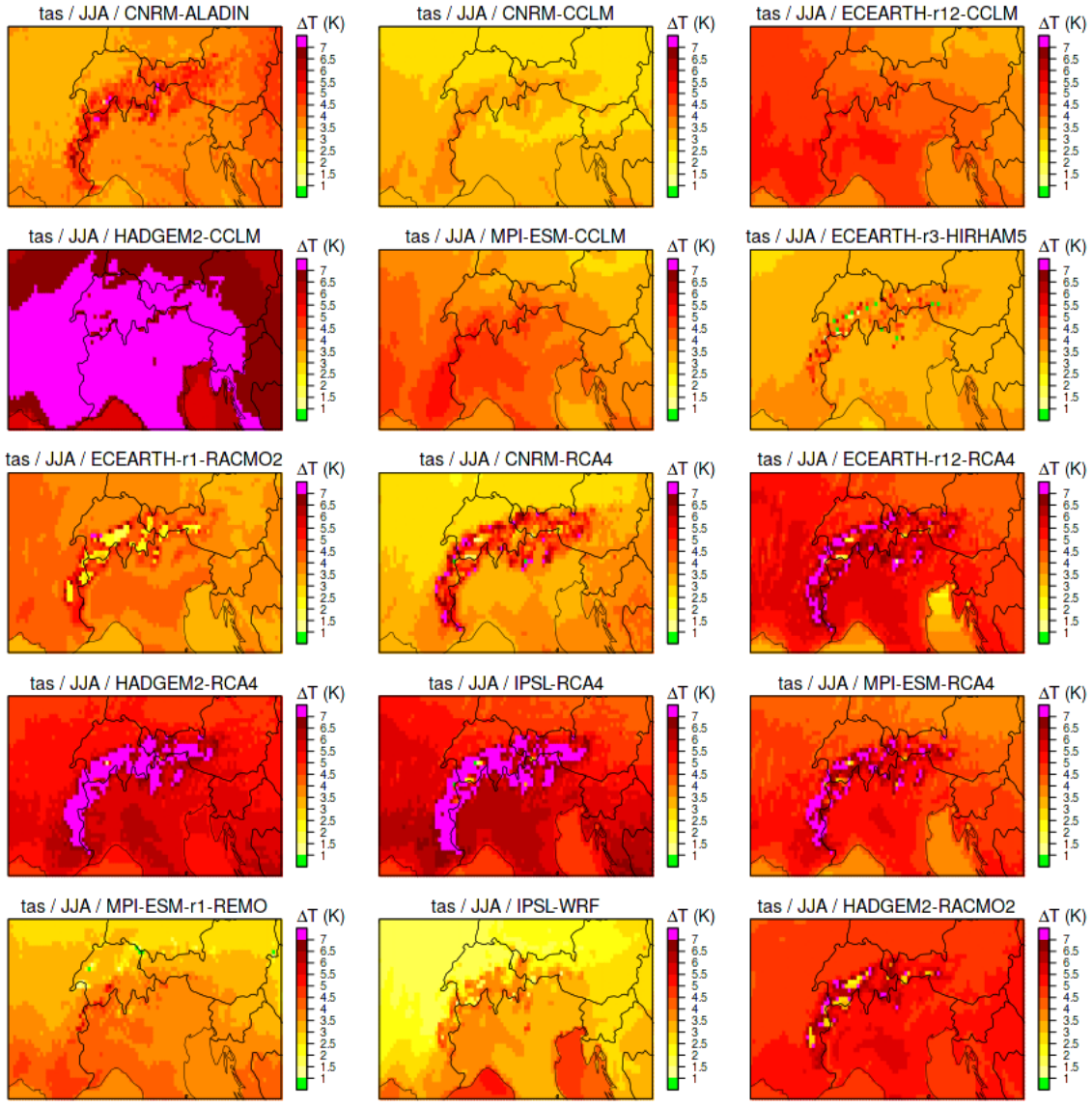

Figure A: Temperature change signal for the summer season (JJA) over the Alpine region (2070-2099 wrt. 1981-2010) for all EUR-11 model chains considered in the original manuscript (and 1st revision) (Table 1) supplied with HADGEM2-RACMO, assuming RCP8.5 from 2006 onwards.

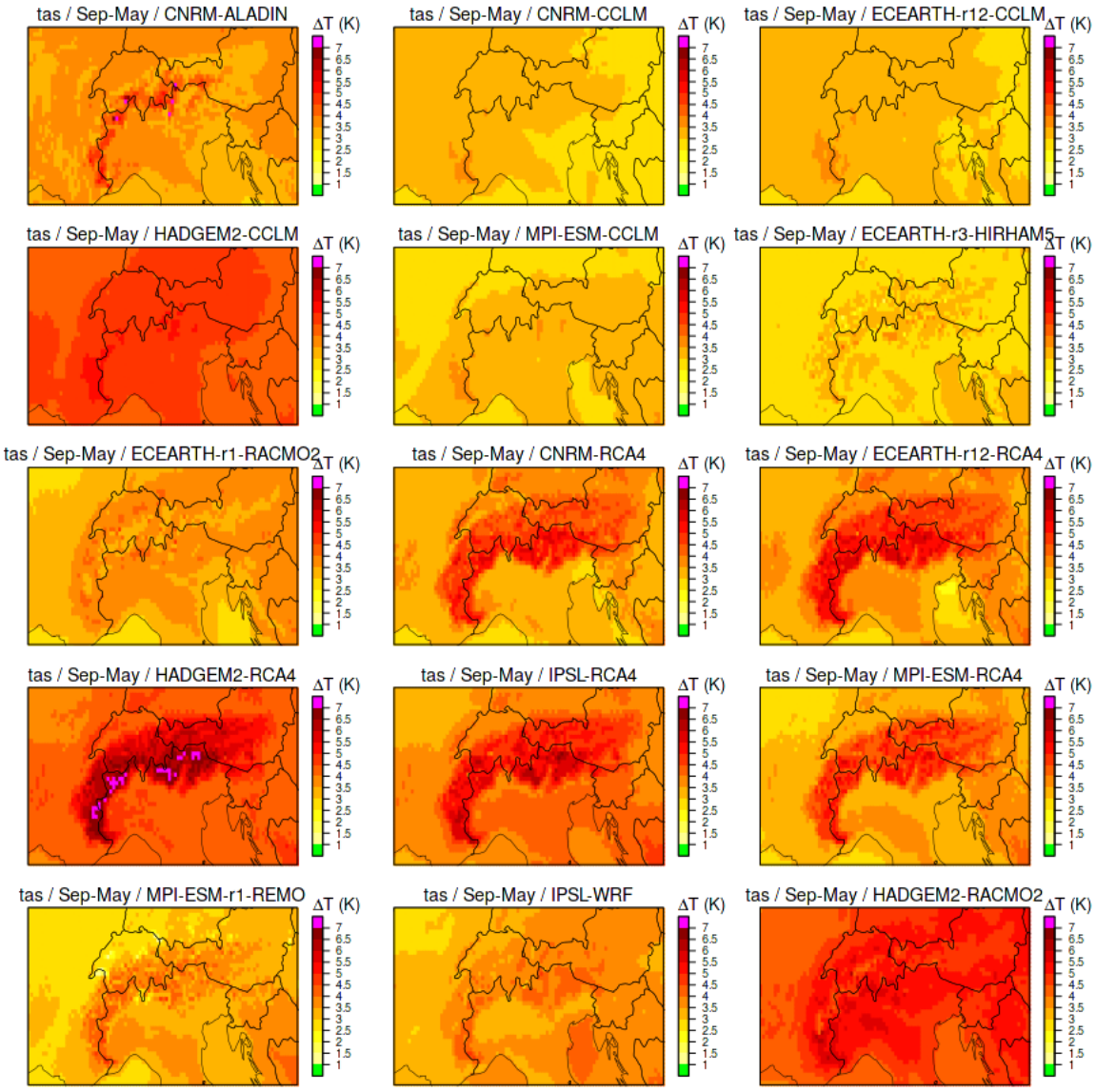

Figure B: Like Figure A, but for the September-May period of the year (SON+DJF+MAM)